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Statement of

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before the

Subcommittee on Space and Aeronautics
Committee on Science
United States House of Representatives

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear today to discuss the past accomplishments and future promise of prize competitions. Prize competitions are proving to be an important tool for innovation, not only for NASA and our Centennial Challenges program, but also for private efforts like the X PRIZE and for other federal agencies like the Defense Advanced Research Projects Agency and their Grand Challenge competition. Congress's attention and support will be important in the months and years ahead to all of these efforts.

I would like to take a few minutes to describe NASA's new prize competition program, Centennial Challenges, including how it supports NASA's new direction, the program's goals, the past prize competitions that Centennial Challenges is modeled on, and recent developments. I will close by outlining future directions for Centennial Challenges and describing how Congress can help support this exciting new program.

Centennial Challenges and the Vision for Space Exploration

On January 14th, President Bush visited NASA Headquarters and announced a new Vision for Space Exploration. The Vision lays out a strategy for sustained, long-term human and robotic exploration of our solar system and the worlds that lay beyond. Embedded within the Vision are many difficult technical challenges, from autonomy and communications to power and propulsion to structures and spacecraft. Meeting these challenges will require us to unleash the best innovative talents our Nation has to offer. Recognizing that NASA needs a dynamic mechanism for tapping the ingenuity of our Nation, wherever it may lie, we created Centennial Challenges.

Centennial Challenges is a very different approach from how NASA, and nearly all federal R&D agencies, have traditionally gone about technical innovation. Instead of

soliciting proposals for a grant or contract award, NASA will set a technical challenge, the prize amount to be awarded for achieving that challenge, and a set of rules by which teams will compete for that prize. Through Centennial Challenges, we hope to:

Stimulate Innovation in Ways That Standard Federal Procurement Cannot – By specifying technical goals but not pre-selecting the best way to achieve them, a large number of approaches to a problem will be developed, including unorthodox approaches that would likely not be pursued in a traditional procurement.

Enrich NASA Research With New Innovators – Centennial Challenge winners will be judged and earn awards based on actual achievements, not proposals. Using this approach, we hope to reach new innovators who would not normally work on NASA issues and find novel or low-cost solutions to NASA engineering problems that would not be developed otherwise.

Help Address Traditional Technology Development Obstacles – In each Challenge, multiple teams will be developing, integrating, testing, or flying various approaches to the same technical goal. With multiple teams and multiple approaches, Centennial Challenges will help transition new technologies into operation and address other traditional technology pitfalls.

Achieve Returns That Outweigh the Program's Investment – History shows that the total resources spent by teams to win prize competitions usually exceeds the value of the prize many times over. By having multiple teams bring varied resources and knowledge to bear on a problem, we will get more solutions developed and tested.

Educate, Inspire and Motivate the Public – Highly visible Challenges will draw substantial public, educator, and student interest in NASA, the competitors, and the technical field of the Challenge itself.

Short History of Prize Competitions

Centennial Challenges is modeled on and builds on the success of prior prize competitions in stimulating technological innovation, scientific discovery, and new exploration achievements.

As early as the 18th century, the British government offered the Longitude Prize, a competition for a navigational solution to the accurate determination of longitude on the high seas. At the time the prize was set, it was assumed that the solution laid in using star maps as navigational aides and that the winner would be an astronomer.
The solution was actually achieved by a London clockmaker and his invention, the marine chronometer.

In the early 20th century, numerous prizes were offered for new achievements in aviation by governments, the U.S. airmail service, wealthy individuals, and even newspapers in both the United States and Europe. Perhaps the most famous of these aviation prizes was

the Orteig Prize for the first crossing of the Atlantic Ocean by air. Again, at the time the prize was set, many assumed that a famous Arctic explorer of that age would win. Instead, a relatively unknown airmail pilot named Charles Lindbergh won the Orteig Prize and went down in history as the first person to cross the Atlantic in an airplane, opening a new avenue of transcontinental transportation.

These two historical examples demonstrate an important advantage of prize competitions – the ability to reach out to new inventors, innovators, and risk-takers and have them apply their experience, thinking, and resources towards the development of novel and unorthodox solutions. It is exactly these kinds of unexpected winners and their ingenious solutions that we hope to identify and leverage through Centennial Challenges.

More recently, the privately funded X PRIZE Foundation has demonstrated the tradition of prize competitions in stimulating innovative solutions to technical challenges. Established in 1996 with the goal of demonstrating private, reusable, suborbital human space flight, the X PRIZE spurred Mike Melvill's June 21st test flight above 100 kilometers, making him the first astronaut to fly a vehicle developed by the private sector to space. The achievements of Burt Rutan and Scaled Composites, the team behind Melvill's flight, are a remarkable private sector engineering achievement. We at NASA are looking forward to a winning X PRIZE team, hopefully later this year.

The science and engineering community has long recognized the value of prize competitions. In 1999, the National Academy of Engineering conducted a blue ribbon workshop titled "Concerning Federally Sponsored Inducement Prizes in Engineering and Science." The central recommendation of this workshop's report was that:

> *"Congress should encourage federal agencies to experiment more extensively with inducement prize contests in science and technology."*

The workshop's report also includes a number of important recommendations regarding how agencies should structure and conduct prize competitions.

The Defense Advanced Research Projects Agency (DARPA) is the first federal agency to pursue the Academy's recommendations and establish a major prize competition. The DARPA Grand Challenge is an annual race aimed at developing autonomous vehicle capabilities for the battlefield, and the first race was held earlier this year in the California desert. We at NASA have a great deal of interest in autonomous systems and robotics and are eagerly anticipating next year's Grand Challenge race.

Recent Developments

Building on this successful history and recognizing the potential value of prize competitions to augment our ability to implement the Vision for Space Exploration and ongoing NASA programs, we conducted an internal study to gather ideas for NASA prize competitions. Two of the founders of the X PRIZE, including Dr. Peter Diamandis who is with us here today, assisted with this study. We collected almost 130 prize competition

concepts and winnowed the list to 15, which was the basis for the initial formulation of Centennial Challenges.

However, we also recognized the need to obtain external inputs on our future prize competitions. Since the teams competing for a particular Challenge will come from outside NASA, we felt it was important to understand what Challenges outside organizations would be interested in competing for and to get their thoughts on how to structure these competitions. To obtain these external inputs, we held the first annual Centennial Challenges Workshop here in Washington last month. The two-day workshop was a great success, both in terms of the attendance and the inputs we received. Over 200 attendees participated, including representatives of both established and emergent aerospace companies, representatives from other industry sectors, researchers from universities and non-profit organizations, members of various financing communities, educators and students, representatives of space advocacy groups, and even hobbyists and interested members of the public. About 30 managers from NASA's field centers, from other federal R&D agencies, and from the X-PRIZE Foundation helped moderate the workshop. Keynote speakers included a member of Congress, the President's Science Advisor, and a captain of the emergent aerospace industry. Together, these participants provided invaluable inputs. They identified excellent prize competition concepts that were missed by our internal study and gave us important feedback on goals and rules for specific competitions. The inputs from the workshop are summarized in a report that is available through a link on our website at www.centennialchallenges.nasa.gov.

Simultaneous with our workshop, the President's Commission on Implementation of U.S. Space Exploration Policy released its report titled "A Journey to Inspire, Innovate and Discover." Among the many important recommendations made by Chairman Pete Aldridge and the Commission is that:

> *Congress increase the potential for commercial opportunities related to the national space exploration vision… by creating significant monetary prizes for the accomplishment of space missions…*

The Commission goes on to state, "NASA should expend its Centennial prize program to encourage entrepreneurs and risk-takers to undertake major space missions." We have taken the Commission's words to heart and are actively exploring ambitious prize competition concepts.

Future Directions for Centennial Challenges

My Centennial Challenges Manager, Mr. Brant Sponberg, and his staff are currently hard at work revising their program plan based on the inputs from our internal study, the June workshop, and the Commission report and are developing the specific prize competitions that NASA would like to begin in FY 2004 with a few small ($250,000) prizes and then expand the effort in FY 2005. Examples of the kinds of Challenges they are examining include prize competitions:

For Full Missions – These would be prize competitions for the successful completion of a challenging robotic or human space mission by a private sector organization. The size the purses for these kinds of prize competitions would be in the single to few tens of millions of dollars and competitors will likely include aerospace companies and university teams. Examples include Challenges for: the first private robotic soft landing on the Moon, the return of samples from near-Earth asteroids, or even the first private orbital human space flight.

For Key Technologies – These would be prize competitions for the successful development and demonstration of a technological capability that is important to future space exploration or other NASA programs. The size of the purses for these prize competitions would range from hundreds of thousands of dollars to a few million dollars and competitors will likely include industry researchers, university researchers, and other inventors. Examples include Challenges for: a more dexterous astronaut glove; an aerocapture mission demonstration; a highly accurate descent and landing system; autonomous robots capable of retrieving science samples from Earth environments that are analogous to those on other worlds; a highly-efficient and low mass power distribution system for robotic or human bases on other worlds; and highly efficient lunar resource processing techniques.

To Leverage Partnering Opportunities – These would be prize competitions for technical goals and capabilities that are common between NASA and other organizations. The size of the purses for these prize competitions would range from hundreds of thousands of dollars to a few million dollars. Partners would cost-share the purse with NASA or be responsible for competition administration. Partners could include: professional organizations, corporations and non-profit research organizations, other federal R&D agencies, hobbyist organizations, and public space advocacy groups. Examples include Challenges for: an autonomous, low mass drilling system for accessing underground science samples and resources on other worlds and on Earth; an improved power storage system for rovers and for various Earth-based applications; a fully autonomous unmanned aerial vehicle for cargo delivery; high strength-to-weight materials; and a solar sail mission to provide space weather data for various government customers.

For Educational Enrichment – These would be prize competitions to excite and encourage college and secondary school students to pursue educations and careers in science, technology, engineering, and math. The size of the purses for these kinds of prize competitions would range from the thousands to tens of thousands of dollars. Examples include a robot "survivor" contest and a contest for a model rocket that must launch after being dropped from a certain height and re-land.

In all of these competitions, it will be important to review the proposed rules to ensure that: they are fair, objective and transparent; that they cannot be "gamed" by competitors; and that they will attract a strong field of competitors. Depending on the size of the prize purse, we plan to subject the draft rules for each competition to independent internal and/or external review. In the case of the largest prize competitions, we will likely have a public comment period to obtain additional inputs on draft rules.

With the exception of those prize competitions targeted at students, we plan to make all Challenges open to any U.S. competitor who is not a federal employee. My program manager is committed to keeping overhead costs low so the maximum amount of funding is available for prize purses. We will shortly release a request for information (RFI) to solicit inputs on how to structure Centennial Challenges support and maintain low overhead.

Congressional Support Is Key

Congress is important to the success of Centennial Challenges. NASA has requested specific authority from Congress to conduct large prize competitions with purses up to $50 million in size and to retain funding for prize purses over multiple years. Both of these authorities are important to maximize the utility of Centennial Challenges. Without them, the ability of Centennial Challenges to conduct prize competitions for space missions or significant technology demonstrations and to partner with other NASA programs will be greatly diminished. NASA's FY 2005 budget request for Centennial Challenges is $20 million, and NASA has included a $2 million reprogramming change in the FY 2004 Operating Plan to undertake a few small ($250,000) prizes.

Centennial Challenges is an exciting and integral part of NASA's new direction. It represents an opportunity to reach new communities of innovators and to find novel solutions to hard technical hurdles. I greatly look forward to our future prize competitions, the new approaches that they will inject into our programs, and to one day shaking the hand of our first Challenge winner. Thank you for the forum that the Committee provided today. I look forward to responding to your questions.